Consequence-Based Management of Railroad Bridges enabled by Structural Health Monitoring

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ABSTRACT

To increase overall profitability, add capacity to rail operations, and comply with new federal regulations on bridge safety, North American railroads are exploring means to improve the management of their bridge networks. Current maintenance, repair, and replacement (MRR) decisions are informed by bridge inspections and ratings, which recommend observing the response of bridges under trains. However, an objective relationship between bridge responses, bridge service state condition, and the associated impact to railroad operations has yet to be established. If the consequences of MRR decisions could be better determined, then the railroads could more effectively allocate their limited resources. This paper develops an approach for consequence-based management of bridge networks, adopted from the field of seismic risk assessment, for making MRR decisions on a network-wide basis. The proposed framework employs fragility curves to relate service condition limit-states to bridge displacement traffic. The operational costs associated with these service conditions can be used to estimate the total costs of a given MRR policy. In this way, optimum MRR decisions can minimize the total network costs. Additionally, measured bridge data can be used to update periodically the fragilities. This framework provides a consistent approach for the prioritization of railroad bridge MRR decisions.